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Design and Development of Garlic Peeling Machine by Human Powered Flywheel Motor Concept for Rural Dwellers Development

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Abstract— *This invention is a new proposed model of peeling the garlic skins with mechanical functionality. Working with the simple and basic mechanism, this is utilising to peel the skin of garlic cloves. This device consists of components like flywheel, process unitand peeler. It reduces the time consumption and protects the hand fingers from the welfare issues like irritation in fingers and nail breakings.*
Keywords—Peddling unit, transmission unit (gears, etc.), bicycle mechanism, garlic peeler.

I. INTRODUCTION

The garlic is the basic ingredient for cooking, pickle industries, hotels, wedding halls, and also for some medical purposes etc. Removing of garlic peel is a tedious process in today's daily life. It takes more time when it comes in cooking. Though, large quantities of garlic time consumption for removing the peels is much more and creates some health issues like irritation in fingers and breakings of nails in the kitchen. The breaking of nails creates pain in the fingers and disturbs other works too. To address these problems and to peel the skins of the garlic, we are invented a new mechanical device to peeled out the garlic skins. It ensures that reduction in time consumption and protects the fingers from the health issues like irritation in fingers and nail breakings.

Garlic is valued for its flavour and commands an extensive commercial importance because of its wide medicinal value and application in food, pharmaceutical and laboratory preparations. It has been cultivated for centuries all over the world on account of its culinary and medicinal properties.

Fig 1: Garlic

II. CONCEPT OF FLYWHEEL MOTOR

On an average, the power produced by a man is approximately 75W (0.10hp), if he works continuously.Therefore human power may be used for a process if the power requirement is maximum near about 75Watt. If process power requirement is more than 75W and if the process can be of an intermittent nature without affecting the end product, a machine system can be developed that stored the energy.

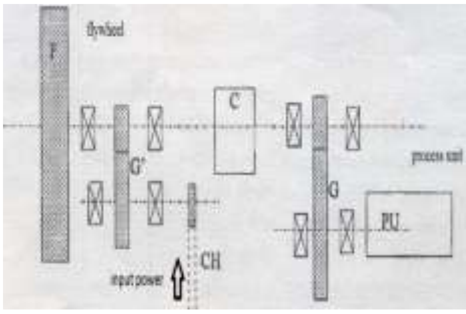

Fig 2: Schematic Conceptual Diagram

III. PAST REVIEW ON HUMAN POWERED MACHINE

1] J.P.Modak, In this paper, a human powered bricks making machine has been designed and development. The machine uses the human operated flywheel motor as power energy source and they said that this concept can be adopted for human powered process unit needing more than 2 KW

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short term power and which could have intermittent operation without affecting the end product. Essentially machine consist of three sub system i.e. 1. Energy Unit, 2. Appropriate transmission 3. Process Unit. They have used gear pair for torque increment and other one for speed increasing while connected with spiral jaw clutch.

2] **K.S.Zakiuddin** Stated the importance of humanenergizing power from the earliest time to the present and its necessity to different machine with future scope. They classified human powered Machine with its different examples according to its varioustypes withprovided information about Dynapods. Finally, this paper explains the Human Powered Flywheel Motor concept with line diagram which contain Bicycle.

3] Praveen Kiran Mali, stated human powered of flywheel is applied for maize threshing process which finds suitable and variable and reduces human effort compared to hand operated machine as hand operated machine requires two operators whereas new machine requires only one. This machine provides comfort for seating arrangement for different position depending upon ergonomics.

IV. ESTIMATION OF DEMAND POWER AND DESIGN OF PARTS

i) Estimation of demand power: - A systematic and suitable procedure is needed for good design. For design of any machine, firstly a demand power for the proposed machine is being calculated. This rated power is became an elevated centre for the estimation of dimensions of components used in present machine. This is in a methodical manner presented in forthcoming articles. Forcerequired to peel the garlic is given by, Where: F = centripetal force; m = mass of discs; w = angular velocity; r = max disc radius. The angular velocity (Ш) is given by Ш =27.89 rad/sec.Therefore peeling force is given by F =105.131 N. Hence, the power needed to drive the shaft at 266.4 rpm is calculated from P = F * V=263.58 watt, Approx. 264 watt, Where V = w * r =2.512 m/s, Now, to calculate power = 0.35 HP, Torque developed at shaft is given by,

T = F * r = 9.45 N-m. Thus this torque is applied to processing shaft. Thus from above calculations, it is somehow confirmed that the demand power for peeling of garlic is equal to 0.3 hp. However, at present the torque due to pairs of gears and frictional torque due to used bearings are not considered too much more. Hence, it is assumed that to reduce this torques and overload conditions it may further demand for 0.2 hp. That's why the totally power supplied to the machine will be approx.(0.3+0.2) = 0.5 hp.

Design of Machine Components: Flywheel design, Chain design, Spur gear design, Antifriction design, Shaft design

1] Chain Design:

Design Power: Pd = PR * KL.....KL= 1.4 (FOR Heavy Loads Minm 10 hrs / day)

Pitch circle diameter: $D_p = p*\eta/s*(1/T)$

Pitch line velocity: $V_p = \pi D_p.N_p/6*1$

Power capacity / strand: P

$=P^2 * \{(V_p/1)-(V^{1.4}/\delta)*(26-2\delta\cos(1/1)*-K_c$

Length of chain in pitches: (Lp)

$= \{(Tg+Tp/2) + (2L/p) + (P (Tg-Tp)/4C)\}$

Recommended wear load:

$Fw = 0.35*P^2=56.451$ N

Maximum permissible bored

d < (Tp - δ/4) * P < 340d< (Td<(Tp-5/4) * P < 34092 =

Hence design is safe.

2. Flywheel Design:

Calculate the mass of flywheel= ρ*w*h*π*D,

Calculate the kinetic energy, K.E.= $\frac{1}{2} * I*\omega^2$

Moment of inertia= mK^2 =D/2: K=D/2,

Power= kinetic energy/ time=0.5 hp,

Let the rim cross section be Am^2,m= p*w*h*d

We know b =2h, A = 2h *h, h= 0.029 =29mm ,

b=2h= 2*29= 58mm

Now find out stresses in flywheel, Assume

V_s< 1600m/m. $V_s = \pi D_0 N /60 = 6.69$ m/s

Calculate stresses:

Centrifugal stresses $\sigma_{1=} \rho* V_s^2=0.0482$N-mm^2

Stresses due to bending of rim,

$\sigma 2 = \rho* V_s^2*\pi^2* (D_0 / \iota^2*\eta)$

Hence, design is safe.

3. Spur Gear Design:

Design power (Pd): Pd = PR * KL …. K= 1.80 =0.50*180=1hp=746watt

Tooth load, $F_t = (Pd/v_p)$,$V_p = \pi D_p.N_p/60 = 0.278$m/s

Calculate actual value, $F_t = 7/(0.2*3) = 894$ N

PCD of pinion $D_p = m * T_p = 3*85 = 255$mm

$D_g = m*T_g = 3*87=261$mm

$V_p = 0.278*m = 0.9$m/s, Dynamic load,F_d =

$F_d = \{Ft + (2V_p*C_e*b+ F_t)/ 2Vp+\sqrt{C_e*b+ F_t}\}$

C = 5900 (20^0 full depth)

$F_d = 2102.738$ N $F_d > F_b$ ….Hence design is safe.

4. Design of Shaft:

$T_d = 6*P1*K_L / 2\pi N$……….K_L=2,

$T_d = 6*3*2/2*\pi*24 = 24.60$ N-mm.

Resultant bending moment for the point B , C, and D are as follows ;

Resultant BM at B=

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$\sqrt{(M_B^2) + (M_B{}^2)}$ =53.38 N, BM at C = $\sqrt{(M_C^2) + (M_C^2)}$ = 97.94 N

Resultant BM at D = $\sqrt{(M_D^2)+(M_D^2)}$= 68.40 N.

Equivalent twisting moment,

$T_e = \sqrt{(K_m * M)^2 + (K_t * T)^2}$

Now calculating the shaft diameter

$T_e = (\pi/l)*\zeta*d^3$: $66.90*10^3$; d= 20.09mm

Selecting standard diameter, d = 25 mm

5. Design Of Antifriction Bearing:

There are two antifriction bearings C_1 and C_2 used in the experimental setup. The maximum reaction developed at bearing C_2i.e. = 667.33 N is considered for designing the bearing.

1. Equivalent load coming on bearing, Fe, N

Fe = $(XF_r+ YF_a)\, K_s K_o K_p\, K_r$,$F_r$= 667.33 N,$F_a$= 0,

$N_e = F_a/F_r$, e = 0

Selecting self-aligning ball bearing = 1, Y = 2.3 K_p = 1 (no preloaded bearing), Kr = 1(outer race fixed inner race rotating)

K_s = 2 (moderate shock load),Fe = (XFr+ YF_a) $KsK_oK_pK_r$ = (1x 667.33 + 0) x 1 x 1 x 1 x 2= 1334.66 N

Bearing Life,L(revolutionsin Millions= $(C/Fe)^n$ K_{ret} ,.K_{ret} = 1 (reliability = 90%), C = (500)(1/3) x Fe, C = 10818.148 N.

Dimension d = 25 mm, D = 52 mm, B = 15 mm.

V. PROPOSED MODELLING OF GARRLIC PEELING MACHINE HUMAN POWER:

The fabrication of any machine demands sufficient and proper planning while selection of systematic process. Normally, the fabrication is carried out after the design process. Once the required dimension obtained then the only work remains and that is to convert the calculated dimensions into real fabricated model. It is the common that any new idea which is being evolved it needs to be verified to check its performed physical parameters. For the testing purpose the garlic is used.

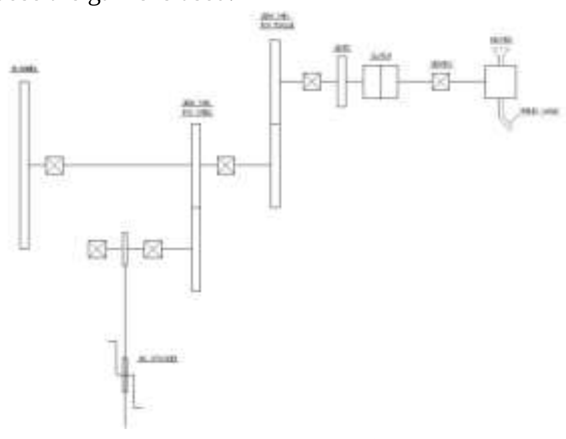

Fig.3: Proposed Model of Machine

VI. CONCLUSION

The traditional peeling machines of garlic are more time consuming, laborious and expensiveness than the power operated garlic peeler developed in the present study.Thesavingincost and peeling time per kg of garlic with the use of the developed peeler is found.

The garlic peel from the mixture of peeled, unpeeled and damaged garlic is separated with the help of air blower.

The machine helps to achieve greater productivity, is energy efficient.

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